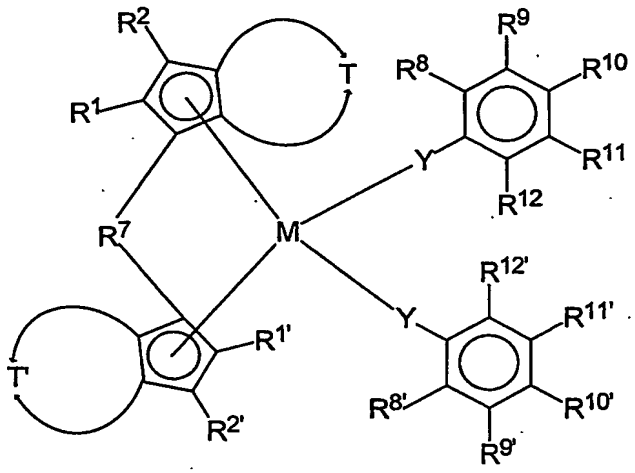
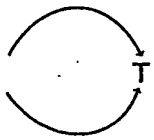
We claim:

1. A process for preparing racemic metallocene complexes of the formula (I)

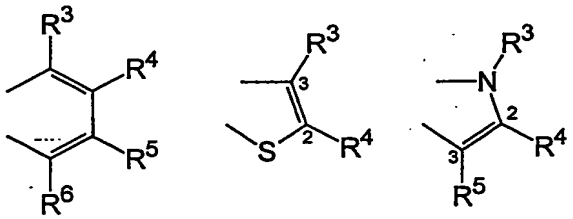


(I)

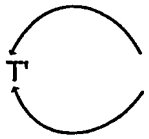
where



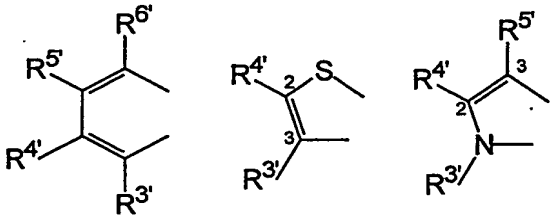
is a divalent group such as



and



is a divalent group such as



and the substituents and indices have the following meanings:

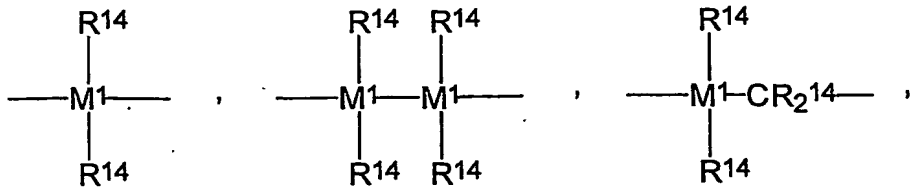
M is titanium, zirconium, hafnium, vanadium, niobium, tantalum, chromium, molybdenum, tungsten or an element of transition group III of the Periodic Table and the lanthanides,

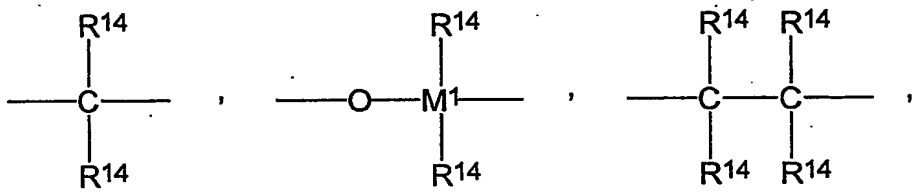
R^1, R^2, R^3, R^4, R^5, R^6, R^9, R^{10}, R^{11}, $R^{1'}$, $R^{2'}$, $R^{3'}$, $R^{4'}$, $R^{5'}$, $R^{6'}$, $R^{9'}$, $R^{10'}$, $R^{11'}$ are identical or different and are each hydrogen, halogen, C_1–C_{20}–alkyl, 3– to 8–membered cycloalkyl which may in turn bear a C_1–C_{10}–alkyl group as substituent, C_6–C_{15}–aryl, alkylaryl having from 1 to 10 carbon atoms in the alkyl part and from 6 to 20 carbon atoms in the aryl part, arylalkyl having from 1 to 10 carbon atoms in the alkyl part and from 6 to 20 carbon atoms in the aryl part, $-OR^{13}$, $-SR^{13}$, $-N(R^{13})_2$, $-P(R^{13})_2$, or $Si(R^{13})_3$, where

R^{13} are identical or different and are each C_1-C_{10}-alkyl, C_6-C_{15}-aryl, C_3-C_{10}-cycloalkyl, alkylaryl, where the radicals mentioned may be partially or fully substituted by heteroatoms,

R^8, R^{12}, $R^{8'}$, $R^{12'}$ are identical or different and are each C_1-C_{10}-alkyl,

Y are identical or different and are each





= BR^{14}, = AlR^{14}, –Ge–, –Sn–, –O–, –S–, = SO, = SO_2, = NR^{14}, = CO, = PR^{14} or = $P(O)R^{14}$,

where

R^{14} are identical or different and are each hydrogen, halogen, C_1–C_{10}–alkyl, C_1–C_{10}–fluoroalkyl, C_6–C_{10}–fluoroaryl, C_6–C_{10}–aryl, C_1–C_{10}–alkoxy, C_2–C_{10}–alkenyl, C_7–C_{40}–arylalkyl, C_8–C_{40}–arylalkenyl, C_7–C_{40}–alkylaryl or two radicals R^{14} together with the atoms connecting them form a ring, and

M^1 is silicon, germanium or tin,

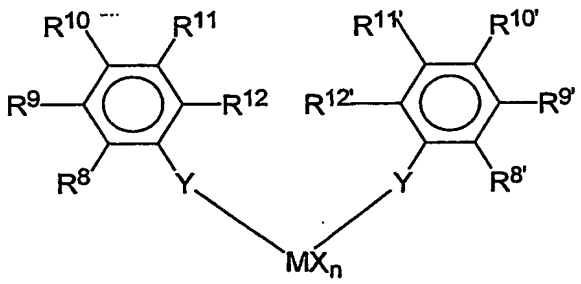
R^7 is a $-[Z(R^{15})(R^{16})]_m-$ group, where

Z can be identical or different and are each silicon, germanium, tin or carbon,

R^{15}, R^{16} are each hydrogen, C_1-C_{10}-alkyl, C_3-C_{10}-cycloalkyl or C_6-C_{15}-aryl,

m is 1, 2, 3 or 4,

by reacting a transition metal complex of the formula (II)



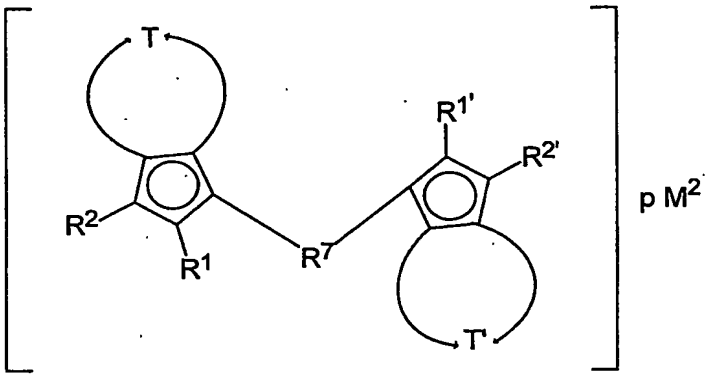
(II)

where

X are identical or different and are each hydrogen, halogen, C_1–C_{10}–alkyl, C_6–C_{15}–aryl, alkylaryl having from 1 to 10 carbon atoms in the alkyl part and from 6 to 20 carbon atoms in the aryl part, –OR^{17} or -NR^{17}_2, where R^{17} are identical or different and are each C_1-C_{10}-alkyl, C_6-C_{15}-aryl, C_3-C_{10}-cycloalkyl, alkylaryl,

n is an integer from 1 to 4 and corresponds to the valence of M minus 2,

with cyclopentadienyl derivatives of the formula (III)



where

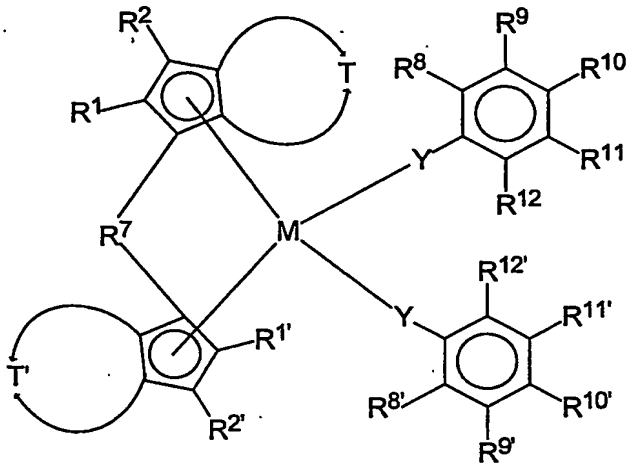
M^2 is an alkali metal ion or alkaline earth metal ion,

and

p is 1 when M^2 is an alkaline earth metal ion and is 2 when M^2 is an alkali metal ion,

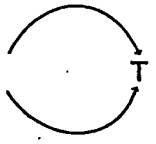
and heating the resulting reaction mixture to a temperature in the range from –78 to +250°C.

2. A process as claimed in claim 1 for preparing racemic metallocene complexes of the formula (I)

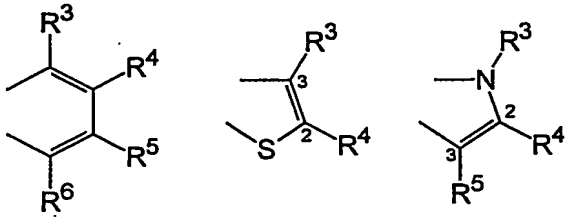


(I)

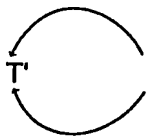
where



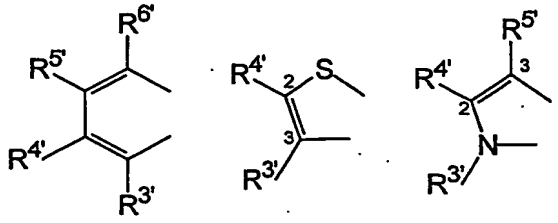
is a divalent group such as



and



is a divalent group such as



and the substituents and indices have the following meanings:

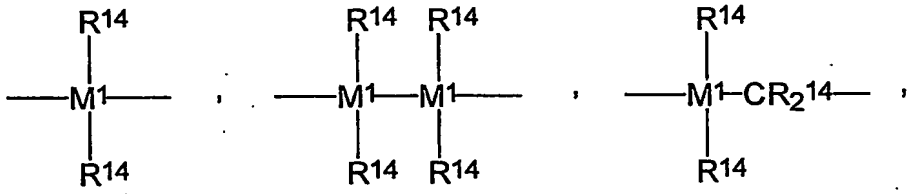
M is titanium, zirconium, hafnium, vanadium, niobium, tantalum, chromium, molybdenum, tungsten or an element of transition group III of the Periodic Table and the lanthanides,

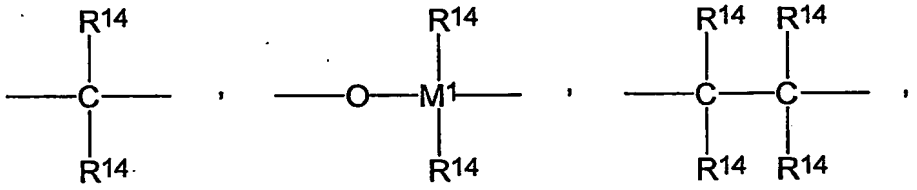
R^1, R^2, R^3, R^4, R^5, R^6, R^9, R^{10}, R^{11}, $R^{1'}$, $R^{2'}$, $R^{3'}$, $R^{4'}$, $R^{5'}$, $R^{6'}$, $R^{9'}$, $R^{10'}$, $R^{11'}$ are identical or different and are each hydrogen, halogen, C_1–C_{20}–alkyl, 3– to 8–membered cycloalkyl which may in turn bear a C_1–C_{10}–alkyl group as substituent, C_6–C_{15}–aryl, alkylaryl having from 1 to 10 carbon atoms in the alkyl part and from 6 to 20 carbon atoms in the aryl part, arylalkyl having from 1 to 10 carbon atoms in the alkyl part and from 6 to 20 carbon atoms in the aryl part,
$-OR^{13}$, $-SR^{13}$, $-N(R^{13})_2$, $-P(R^{13})_2$ or $Si(R^{13})_3$, where

R^{13} are identical or different and are each C_1-C_{10}-alkyl, C_6-C_{15}-aryl, C_3-C_{10}-cycloalkyl, alkylaryl, where the radicals mentioned may be partially or fully substituted by heteroatoms,

R^8, R^{12}, $R^{8'}$, $R^{12'}$ are identical or different and are each C_1-C_{10}-alkyl,

Y are identical or different and are each





= BR^{14}, = AlR^{14}, –Ge–, –Sn–, –O–, –S–, = SO, = SO_2, = NR^{14}, = CO, = PR^{14} or = $P(O)R^{14}$,

where

R^{14} are identical or different and are each hydrogen, halogen, C_1–C_{10}–alkyl, C_1–C_{10}–fluoroalkyl, C_6–C_{10}–fluoroaryl, C_6–C_{10}–aryl, C_1–C_{10}–alkoxy, C_2–C_{10}–alkenyl, C_7–C_{40}–arylalkyl, C_8–C_{40}–arylalkenyl, C_7–C_{40}–alkylaryl or two radicals R^{14} together with the atoms connecting them form a ring, and

M^1 is silicion, germanium or tin,

R^7 is a $-[Z(R^{15})(R^{16})]_m-$ group, where

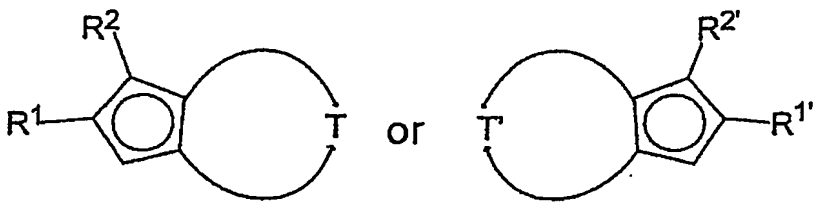
Z can be identical or different and are each silicon, germanium, tin or carbon,

R^{15}, R^{16} are each hydrogen, C_1-C_{10}-alkyl, C_3-C_{10}-cycloalkyl or C_6-C_{15}-aryl,

m is 1, 2, 3 or 4,

comprising the following steps:

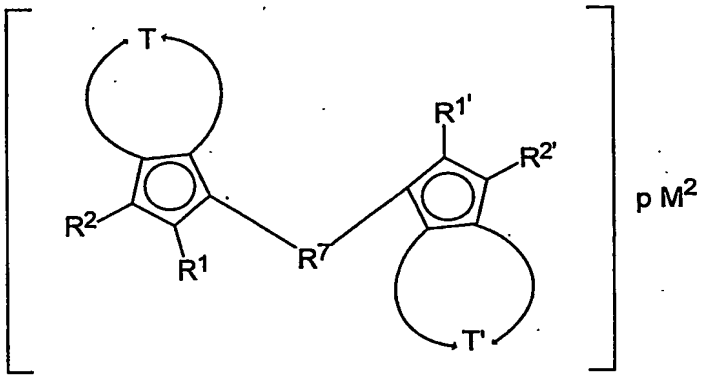
a) deprotonation of a compound of the formula (IV)



(IV)

by means of a suitable deprotonating agent;

b) reaction of the deprotonated compound (IV) with a compound R^7Hal_2, where Hal is a halogen substituent such as F, Cl, Br or I, and subsequent repeat deprotonation by means of a suitable deprotonating agent to give the compound of the formula (III)



(III)

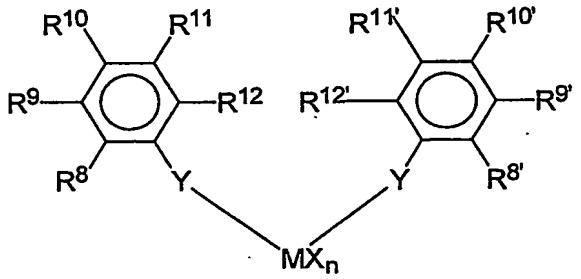
where

M^2 is an alkali metal ion or alkaline earth metal ion,

where

p is 1 when M^2 is an alkaline earth metal ion and is 2 when M^2 is an alkali metal ion, and R^7 is as defined above;

c) reaction of the compound of the formula (III) with a transition metal complex of the formula (II)



(II)

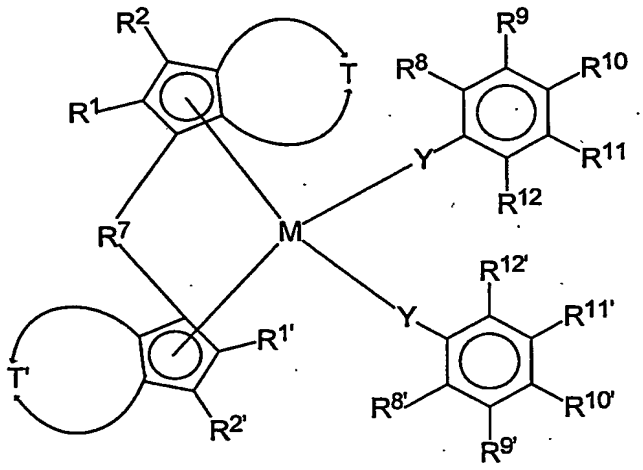
where

X are identical or different and are each hydrogen, halogen, C_1–C_{10}–alkyl, C_6–C_{15}–aryl, alkylaryl having from 1 to 10 carbon atoms in the alkyl part and from 6 to 20 carbon atoms in the aryl part, $–OR^{17}$ or-NR^{17}_2, where R^{17} are identical

to 20 carbon atoms in the aryl part, $-OR^{17}$ or $-NR^{17}_2$, where R^{17} are identical or different and are each C_1-C_{10}-alkyl, C_6-C_{15}-aryl, C_3-C_{10}-cycloalkyl, alkylaryl,

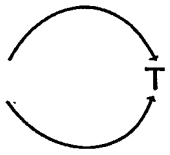
n is an integer from 1 to 4 and corresponds to the valence of M minus 2, and the other substituents are as defined above.

3. A racemic metallocene complex of the formula (I)

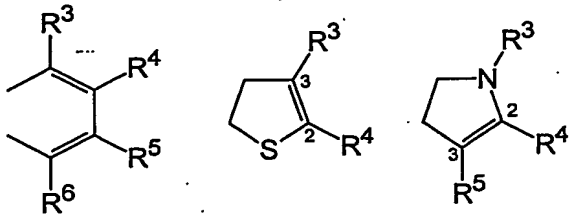


(I)

where



is a divalent group such as



and

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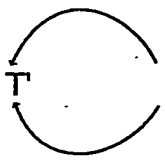
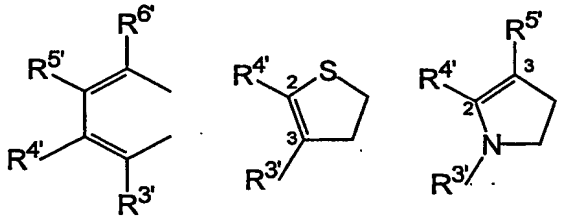


is a divalent group such as



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R^{13} are identical or different and are each C_1-C_{10}-alkyl, C_6-C_{15}-aryl, C_3-C_{10}-cycloalkyl, alkylaryl, where the radicals mentioned may be partially or fully substituted by heteroatoms,

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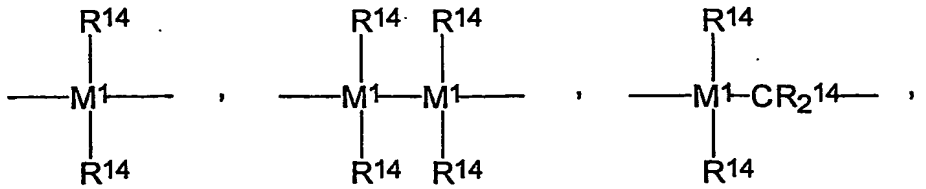

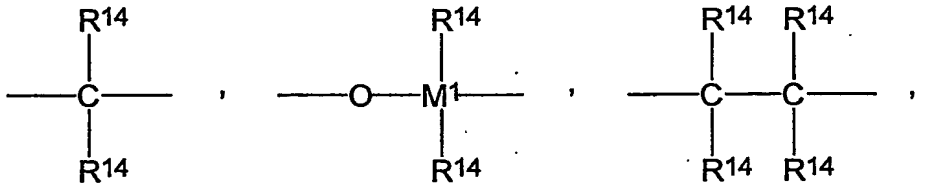

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where

R^{14} are identical or different and are each hydrogen, halogen, C_1–C_{10}–alkyl, C_1–C_{10}–fluoroalkyl, C_6–C_{10}–fluoroaryl, C_6–C_{10}–aryl, C_1–C_{10}–alkoxy, C_2–C_{10}–alkenyl, C_7–C_{40}–arylalkyl, C_8–C_{40}–arylalkenyl, C_7–C_{40}–alkylaryl or two radicals R^{14} together with the atoms connecting them form a ring, and

M^1 is silicon, germanium or tin,

R^7 is a $-[Z(R^{15})(R^{16})]_m-$ group, where

Z can be identical or different and are each silicon, germanium, tin or carbon,

R^{15}, R^{16} are each hydrogen, C_1-C_{10}-alkyl, C_3-C_{10}-cycloalkyl or C_6-C_{15}-aryl, and

m is 1, 2, 3 or 4.

4. A process or complex as claimed in any of the preceding claims, **wherein** the substituents R^8, $R^{8'}$ and R^{12}, $R^{12'}$ are identical and are selected from among methyl, ethyl, n-propyl, i-propyl, n-butyl, sec-butyl and tert-butyl, particularly preferably methyl.

5. A process or complex as claimed in any of the preceding claims, **wherein** the substituents R^1 and $R^{1'}$ are identical or different and are each hydrogen or methyl.

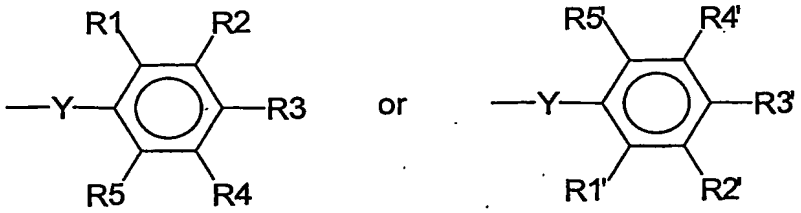
6. A process or complex as claimed in any of the preceding claims, **wherein** the bridging units Y are identical and are each oxygen.

7. A process or complex as claimed in any of the preceding claims, **wherein** M is zirconium.

8. A process or complex as claimed in any of the preceding claims, **wherein** M^2 is magnesium or lithium.

9. A process or complex as claimed in any of the preceding claims, **wherein** R^7 is a dimethylsilyl group or an ethanediyl group.

10. A process as claimed in any of claims 1, 2 and 4 to 9, **wherein**, in a further step, the compound of the formula (I) is reacted with suitable replacement reagents to replace at least one of the groups



by halogen substituents such as F, Cl, Br or I or by linear, branched or cyclic C_{1-10}-alkyl substituents.

11. A process as claimed in claim 10, **wherein** the replacement reagents are selected from among aliphatic and aromatic carboxylic acid halides such as acetyl chloride, phenylacetyl chloride, 2–thiophenacetyl chloride, trichloroacetyl chloride, trimethylacetyl chloride, O–acetylmandelyl chloride, 1,3,5–benzenetricarboxylic chloride, 2,6–pyridinecarboxylic chloride, tert–butylacetyl chloride, chloroacetyl chloride, 4–chlorobenzacetyl chloride, dichloroacetyl chloride, 3–methoxyphenylacetyl chloride, acetyl bromide, bromoacetyl bromide, acetyl fluoride, benzoyl fluoride, $SOCl_2$, silicon tetrachloride, organoaluminum compounds such as tri-C_1-C_{10}-alkylaluminums, in particular trimethylaluminum, triethylaluminum, tri-n-butylaluminum, triisobutylaluminum, and dialkylaluminum chlorides, aluminum sesquichlorides, methylaluminum dichloride, dimethylaluminum chloride, aluminum trichloride and ethylaluminum dichloride and combinations thereof.

12. A process as claimed in claim 10,
wherein replacement reagents used are HF, HBr, HI, preferably HCl, as such or as solutions in water or organic solvents such as diethyl ether, DME or THF.

13. A process as claimed in any of claims 1, 2 and 4 to 12,
wherein the deprotonating agent is selected from among n-butyllithium, tert-butyllithium, sodium hydride, potassium tert-butoxide, Grignard reagents of magnesium, magnesium compounds such as, in particular, di-n-butylmagnesium, (n,s)–dibutylmagnesium and other suitable alkaline earth metal alkyl and alkali metal alkyl compounds.

14. A process as claimed in any of claims 1, 2 and 4 to 13,
wherein no intermediates are isolated during the process.

15. A complex as claimed in claim 3 selected from among dimethylsilylbis(1-indenyl)zirconium bis(2,4,6-trimethylphenoxide), dimethylsilylbis(2-methyl-1-indenyl)zirconium bis(2,4,6-trimethylphenoxide), dimethylsilylbis(2-methyl-1-indenyl)zirconium bis(2,6-dimethylphenoxide), dimethylsilylbis(2-methyl-1-indenyl)zirconium bis(2,6-dimethyl-4-bromophenoxide) and ethanediylbis(1-indenyl)zirconium bis(2,4,6-trimethylphenoxide).

16. The use of a racemic metallocene complex as claimed in any of claims 3 to 9 and 15 as a catalyst or as a constituent of a catalyst for the polymerization of olefinically unsaturated compounds or as a reagent or catalyst in stereoselective synthesis.